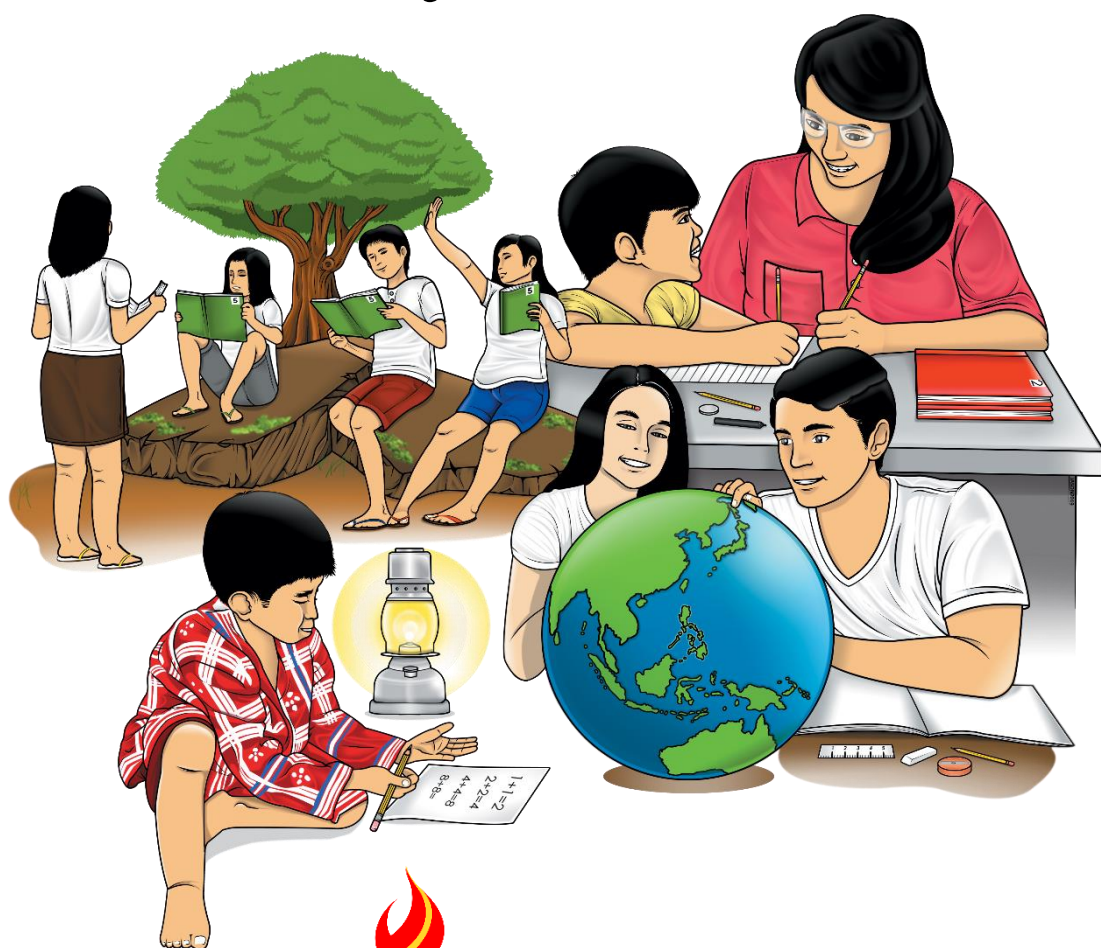


Science

Quarter 2- Matter

Module 3: Ions: How Are They Formed?



Science – Grade 9

Alternative Delivery Mode

Quarter 2: Matter - Module 3: IONS: How Are They Formed?

First Edition, 2020

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Science
Quarter 2- Matter
Module 3: IONS: How Are
They Formed?

Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.



What I Need to Know

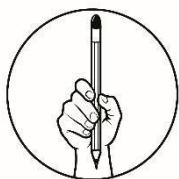
This module was designed and written with you in mind. It is here to help you master IONS: How Are They Formed? The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged to follow the standard sequence of the course, but the order in which you read them can be changed to correspond with the textbook you are now using.

The module focuses on achieving this learning competency:

Explain how ions are formed. (S9MT-IIe-f-16)

After going through this module, you are expected to:

- describe ions and how it is formed;
- differentiate cations from anions based on their tendency to lose or gain electrons;
- show the formation of ions using Lewis Electron Dot Symbols (LEDS); and
- write chemical formula of ionic compounds based on the charges of ions.



What I Know

Choose the letter of the best answer. Write your answer on a separate sheet of paper.

1. What do you call the ion which carry positive charge in its atom?
A. Anions
B. Cations
C. Polyatomic ions
D. Polymers ion
2. What do you call the ion which carry negative charge in its atom?
A. Anions
B. Cations
C. Polyatomic ions
D. Polymers ion

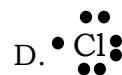
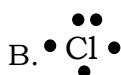
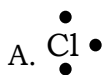
3. An element is found in Family II and Period III of the Periodic Table of elements. What is its valence electron?

A. 1 B. 2 C. 3 D. 5

4. What is the basis of Lewis Dot Structure?

A. Anions
B. Cations
C. Period Number
D. Valence Number

5. Which LEDES is the correct structure for Chlorine (Cl)?



6. Which type of elements tend to gain electron/s during ionic bonding?

A. metals
B. metalloid
C. non- metal
D. super alloy

7. During the experiment, a scientist found out the following characteristics of elements.

Characteristics	A	B	C	D
Mass	0.10 g	0.20 g	0.30g	0.40g
Transfer of Electron	Gain	Lose	Lose	Gain
Reactivity	YES	YES	YES	YES

As a scientist, which do you think are the metals in the results of the experiment as stated in the Table above?

A. A and B C. B and C
B. A and D D. B and D

8. Which type of elements tends to lose electron/s during ionic bonding?

A. metals
B. metalloid
C. non- metal
D. super alloy

9. What is the correct chemical formula for the ionic compound containing Calcium ion and Chlorine ion?

A. CaCl B. Ca₂Cl C. CaCl₃ D. CaCl₂

10. MgBr₂ is the chemical formula for magnesium bromide. What does the number "2" in the formula mean?

A. Bromine has 2+ charge
B. Bromine has 2- charge
C. There are 2 Bromine ions in every magnesium ion
D. There are 2 Magnesium ions in every bromine ion

Lesson

1

IONS: How Are They Formed?

In the previous module, you have learned the different types of compounds based on their properties such as melting point, hardness, polarity and electrical and thermal conductivity. In this module, you will learn about ions and how they are formed. You are going to figure out what types of ions are formed when atom lose and gain electrons during chemical bonding.

Here are some key questions for you to ponder after finishing this module:

1. What are ions and how are they formed?
2. What is the difference between cations and anions?
3. How is the formation of ions using Lewis Electron Dot Symbols (LEDS) shown?
4. How is the chemical formula based on the charges of ions written?



What's In

Let's recall your understanding of the different types of compounds based on their property.

Write **I** if the statement describes an ionic compound, **C** if the statement describes a covalent compound.

- _____ 1. It conducts electricity when dissolved in water.
- _____ 2. It has a high melting point.
- _____ 3. Does not conduct electricity.
- _____ 4. Insoluble in water.
- _____ 5. It has a low boiling point
- _____ 6. It is formed through losing and gaining electrons.
- _____ 7. Consist of positive and negative charged particles.
- _____ 8. Bond between two nonmetals.
- _____ 9. Bond between a metal and a nonmetal.
- _____ 10. Formed through sharing of electrons.



What's New

Read the comic strip below. Identify the main focus of the lesson. Point out some important details that will be discussed to answer the activities provided for you.

The comic strip consists of six panels illustrating the formation of an ionic bond:

- Panel 1:** A stick figure labeled 'Na' with one valence electron looks sad. A thought bubble says: "I wish to become stable. But I have one valence electron."
- Panel 2:** A stick figure labeled 'Cl' with seven valence electrons looks sad. A thought bubble says: "(Weeping) I am SO close to having a full valence electron!!"
- Panel 3:** 'Na' says to 'Cl': "Excuse me Miss Chlorine. I have an idea. I can give you my valence electron so that you and I will both become stable."
- Panel 4:** 'Cl' responds: "You're right Mr. Sodium! I can accept your valence electron so that both of us will become stable."
- Panel 5:** 'Na' has lost its valence electron and says: "I am now a cation because I gave away an electron." 'Cl' has gained the electron and says: "I am anion now because I accepted an electron."
- Panel 6:** The two ions are shown with '+' and '-' signs. A box says: "Our positive and negative charges attract! We are now held together by an ionic bond." The chemical formula NaCl is written above them.



What is It

Chemical Bonding

Chemical bond is a term use to describe the attraction of atoms that are combined together through sharing and transferring their valence electrons.

An atom is made up of a nucleus where protons and neutrons are located. It also has electrons that are found in certain energy levels that are rotating around the nucleus. Electrons are the particles that are involved in chemical bonding. These electrons are known as the valence electrons that are located in the outermost shell.

IONS: How Are They Formed?

Ions are atoms or groups of atoms that has positive or negative charge.

Ions are formed when an atom lose or gain its electrons. If metals were chemically combined to nonmetals, metals would tend to lose electron while nonmetals gain electrons during chemical bonding to attain stability. For an atom to attain stability, they must have 8 valence electrons in their outermost shell. This is known as OCTET RULE.

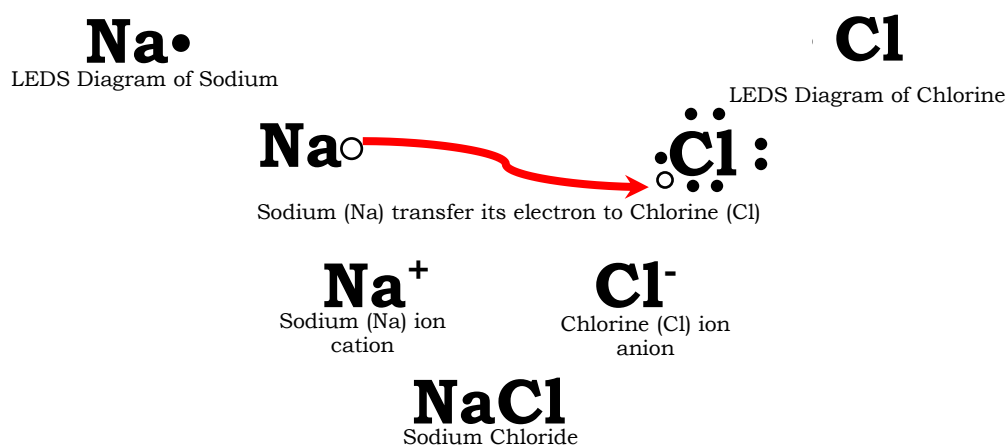
Let us consider Sodium and Chlorine. Sodium is a metallic element under Group 1A. It has one (1) valence electron. Chlorine on the other hand, is a non-metallic element under Group 7A, it has seven (7) valence electrons. Sodium needs 7 electrons to follow the Octet rule, while Chlorine needs 1 valence electron. It is easier for Sodium to give away its one (1) valence electron to become more stable than to get seven (7) valence electrons. Therefore, when Sodium (Na) and Chlorine (Cl) bond together, Sodium will give its one (1) valence electron to Chlorine so that Sodium will become stable. On the other hand, Chlorine also becomes stable when it accepts the one (1) valence electrons given by Sodium.

Cation and Anion

When an atom loses or gains electrons, they formed ions. An atom that loses electrons becomes a positively charged ion known as cation. An atom that gains electrons become negatively charged ion known as anion.

Lewis Electron Dot Structure (LEDS)

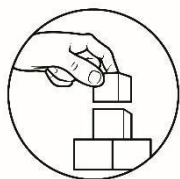
Lewis Electron Dot Structure is introduced by Gilbert N. Lewis, an American Physical Chemist. LEDS is composed of the symbol of the element and dots which represent the number of valence electrons of an atom that can easily be determined through the group/family number in the Periodic Table of Elements. Consider the following example:



Writing Chemical Formula of Ionic Compounds Based on the Charges of Ions

Chemical compound can be described using chemical formula which represents the elements that are found in a compound. In writing the chemical formula of ionic compound, first identify the cation and write its symbol and charge. Then, identify the anion and write down its symbol and charge. After doing so, write the symbol of the ions to form the compound. Another way of writing the chemical formula of ionic compound is using the crisscross method. In this method, cross the value of charge of each ion to become subscript, the positive and the negative sign will be omitted. Reduce the number of the charges to lowest term and leave out all subscripts that are 1.

- | | |
|-----------------------|--|
| 1. Mg^{2+} O^{2-} | Consider the Magnesium Ion and Oxygen Ion. |
| 2. Mg^{2+} O^{2-} | 1. Write the charges of each ion. |
| 3. Mg_2 O_2 | 2. Cross the charges to become subscript. |
| 4. MgO | 3. Reduce to lowest term, do not write the value if it is 1. |
| | 4. Then write the chemical formula |



What's More

Activity 1: Lewis Electron Dot Structure (LEDS)

Identify the group/family and valence electron of each element, then draw their Lewis Dot Structure. (Note: Use your Periodic Table). You may write your answer on a separate sheet of paper.

Elements	Family/Group	Valence Electron/s	Lewis Symbol
Lithium	IA	1	Li·
Aluminum			
Bromine			
Sulfur			
Potassium			

Nitrogen			
Carbon			
Fluorine			
Magnesium			
Barium			

Activity 2. Metals versus Non-metals/ Cation vs. Anion

Complete the table below following the given example on number 1 (Lithium). Write your answer on a separate sheet of paper.

Element	Metal or Nonmetal	Lose or Gain Electrons	Cation or Anion
1. Lithium	Metal	Lose	Cation
2. Aluminum			
3. Bromine			
4. Sulfur			
5. Potassium			
6. Nitrogen			
7. Carbon			
8. Fluorine			
9. Magnesium			
10. Barium			

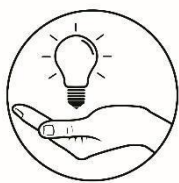
Activity 3. Gain or lose, you choose!

Identify the valence electrons of the following elements. Determine if they are going to lose or gain an electron, then write their ions. Write your answer on a separate sheet of paper.

Element	Valence Electron	# of electrons to lose	# of electrons to gain	Ion formed
N		0		N^{-3}
Li	1	1		
Ca		2		
Br				Br^{-}
Mg	2		0	

Guide Questions:

1. If N gains 3 electrons from another atom, why is it written N^{-3} (with -3 valence number)?
2. If Li loses an electron to another atom, why is it written Li^{+1} (with +1 valence number)?
3. What type of element is Ca as it loses its electrons?
4. If Br gains an electron, what type of ion is formed?
5. If Mg loses its electron, what type of ion is formed?



What I Have Learned

Write the word that correctly completes the statement. Choose your answer from the box below. Word/s can be used twice. Write your answer on a separate sheet of paper.

Anion	Cation	Crisscross
Eight	Gain	Group
Ionic Bond	LEDS	Loss
Positive	Negative	Stable
	Valence Electron	

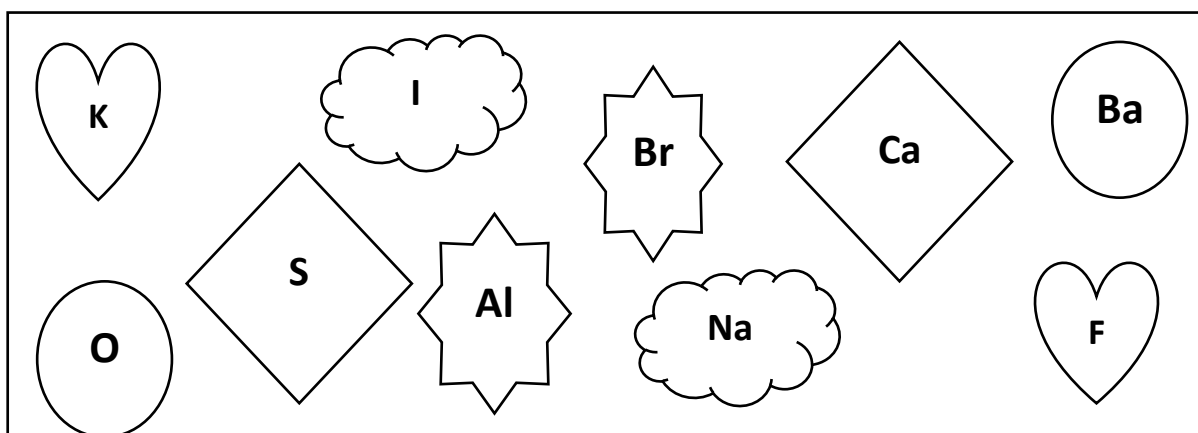
1. The _____ are the outermost electrons which directly involved in chemical bonding.
2. _____ is composed of the symbol of the elements and dots which represent the number of valence electrons of an atom that can easily be determined through the 3. _____ number in the Periodic Table of Elements.
4. An _____ involves complete transfer of electrons; thus, ions are formed. It involves metals with low electronegativity and non-metals with high electronegativity.
5. Metallic elements tend to _____ their electrons thus forming 6. _____, positively charged ions.
7. Non-metallic elements tend to _____ electrons thus forming 8. _____, negatively charged ions.
9. In writing the chemical formula of an ionic compound, we write first the symbol of _____, then followed by the symbol of 10. _____.
11. An atom wants to fill its outermost energy level with _____ electrons and become 12. _____.
13. Another way of writing the chemical formula of ionic compound is the _____ method. In this method, cross the value of charge of each ion to become subscript, the 14. _____ and the 15. _____ sign will be omitted.



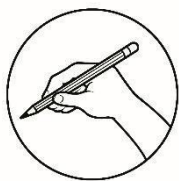
What I Can Do

The Perfect Match

Sodium is a metallic element willing to lose its electron and give to Chlorine during chemical reaction to form NaCl (Sodium Chloride) commonly known as table salt. Now, it is your turn to match the elements to form an ionic compound. After doing so, determine its cation and anion, illustrate the LEDS, and then write the Chemical Formula on the chart below. Write your answer on a separate sheet of paper.



Cation	Anions	LEDS	Chemical Formula
K^+	F^-	$K \cdot \rightarrow \cdot \ddot{F} \cdot$	KF

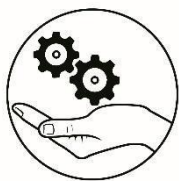


Assessment

Choose the letter of the best answer. Write your answers on a separate sheet of paper.

1. Why do atoms tend to lose or gain electrons during chemical bonding?
 - A. to attain beauty
 - B. to attain stability
 - C. to become reactive
 - D. to attain malleability
2. What do we mean by stable configuration?
 - A. having 5 electrons in the outermost shell
 - B. having 6 electrons in the outermost shell
 - C. having 7 electrons in the outermost shell
 - D. having 8 electrons in the outermost shell
3. What type of element should bond together to form an ionic compound?
 - A. Metal and Nonmetal
 - B. Metal and Metalloids
 - C. Nonmetal and metalloid
 - D. Nonmetal and another Nonmetal
4. When a metal and nonmetal atom bond together to form an ionic compound they become ions, what type of ion is formed by the metal atom?
 - A. Negative Ions
 - B. Neutral Ions
 - C. Positive Ions
 - D. Reactive Ions
5. When a metal and nonmetal atom bond together to form an ionic compound they become ions, what type of ion is formed by the nonmetal atom?
 - A. Negative Ions
 - B. Neutral Ions
 - C. Positive Ions
 - D. Reactive Ions
6. What does it mean if K atom becomes K^+ ions?
 - A. it has lost 1 electron
 - B. it has lost 2 electrons
 - C. it has gain 1 electron
 - D. it has gain 2 electrons
7. Which atom is most likely to form a 3^+ ion?
 - A. Al
 - B. Kr
 - C. Li
 - D. Si

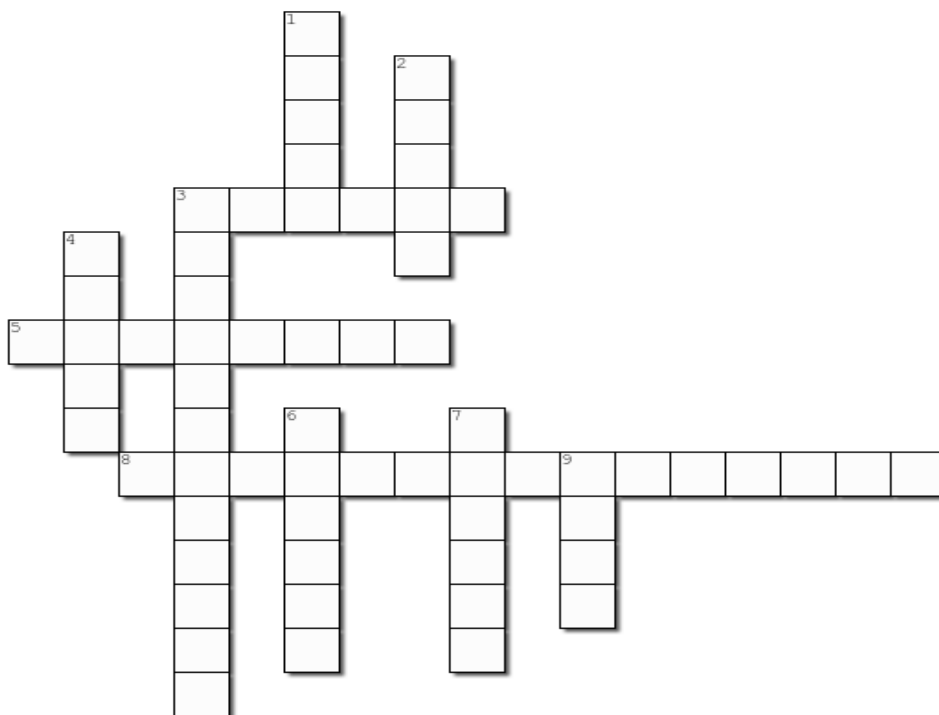
8. Which is true about the elements in a particular group in the periodic table?
- A. they have the same number of protons
 - B. they have the same number of electrons
 - C. they have the same number of energy levels
 - D. they have the same number of valence electrons
9. When writing the chemical formula for an ionic compound, which will you write first?
- A. Positive ion
 - B. Negative ion
 - C. Charge of the ion
 - D. Subscript of the ion
10. How will you write the ion of Bromine that gains 1 electron during the process of chemical bonding?
- A. B^{+1} B. B^{-1} C. Br^{+1} D. Br^{-1}



Additional Activities

Let's Find Out!

Complete the crossword puzzle by filling in a word that fits the given clue. Write your answer on a separate sheet of paper.



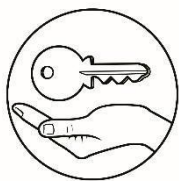
Created using the Crossword Maker on TheTeachersCorner.net

Across

- 3. It refers to the positively charge ions.
- 5. A type of element that tends to gain electrons after chemical bonding.
- 8. It refers to the electrons involved in chemical bonding.

Down

- 1. It refers to the rule when atom is stable and has 8 valence electrons in their outermost shell after chemical bond.
- 2. It refers to the negatively-charge ion.
- 3. A term used when atoms combined through sharing and transferring of electrons.
- 4. It is the columnar arrangement of the elements in the periodic table of elements. This determines the number of valence elect
- 6. These are types of elements that tend to lose electrons during chemical bonding.
- 7. It refers to the arrangement of elements in the periodic table of elements that determines the number or energy shell of each
- 9. It uses dots to represent the valence electrons of the atom.



Answer Key

Elements	Family/Group	Valence Electrons	Lewis Symbol
Lithium	IA	1	Li·
Aluminum	IIIA	3	·Al·
Bromine	VIIA	7	·Br·
Sulfur	VIA	6	·S·
Potassium	IA	1	K·
Nitrogen	VA	5	·N·
Carbon	IVA	4	·C·
Fluorine	VIIA	7	·F·
Magnesium	IIA	2	·Mg·
Barium	IIA	2	Ba·

What's More

1. B
2. A
3. B
4. D
5. D
6. C
7. C
8. A
9. D
10. C

What I Know

1. I
2. I
3. C
4. C
5. C
6. I
7. I
8. C
9. I
10. C

What's In

Activity 2

Elements	Metal or Nonmetal	Lose or Gain Electrons	Cation or Anion
Lithium	Metal	Lose	Cation
Aluminum	Metal	Lose	Cation
Bromine	Nonmetal	Gain	Anion
Sulfur	Nonmetal	Gain	Anion
Potassium	Metal	Lose	Cation
Nitrogen	Nonmetal	Gain	Anion
Carbon	Nonmetal	Gain	Anion
Fluorine	Nonmetal	Gain	Anion
Magnesium	Metal	Lose	Cation
Barium	Metal	Lose	Cation

1. Valence electron
2. LEDES
3. Group
4. Ionic Bond
5. Loss
6. Cation
7. Gain
8. Anion
9. Cation
10. Anion
11. Eight
12. Stable
13. Crisscross
14. Positive
15. Negative

What I Have Learned

Cation	Anions	LEDS	Chemical Formula
K ⁺	F ⁻		KF
Ba ²⁺	O ²⁻		BaO
Al ³⁺	Br ⁻		AlBr ₃
Ca ²⁺	S ²⁻		CaS
Na ⁺	I ⁻		NaI

What Can I Do

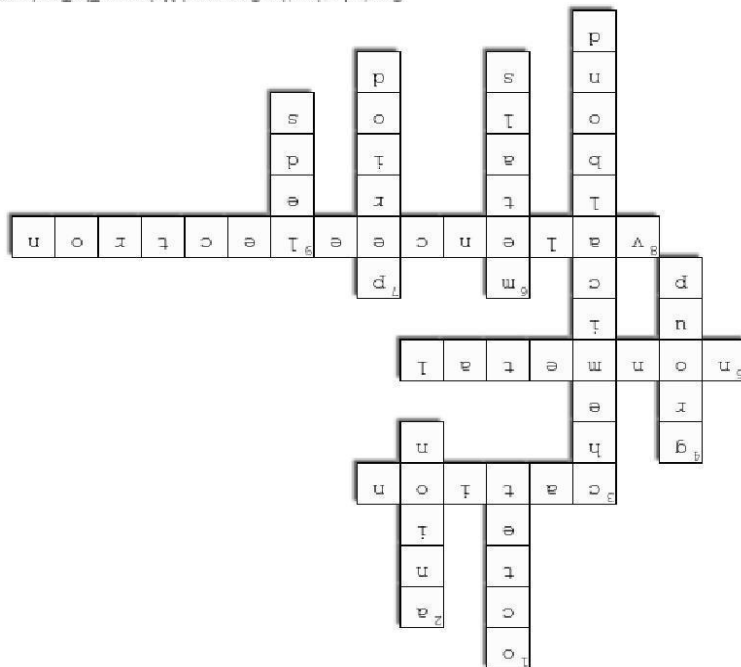
1. It is written as N³⁻ since it has 3 more electrons than protons
2. It is written as Li⁺ since it has 1 more proton than electrons

Element	Valence Electron	# of electrons to lose	# of electrons to gain	Ion formed
N	5	0	3	N ³⁻
Li	1	1	0	Li ⁺
Ca	2	2	0	Ca ²⁺
Br	7	0	1	Br ⁻
Mg	2	2	0	Mg ²⁺

Activity 3

1. It refers to the rule when atom is stable and has 8 valence electrons in their outermost shell after chemical bond. (**octet**)
2. It refers to the negatively-charge ion. (**anion**)
3. A term used when atoms combined through sharing and transferring of electrons. (**chemicalbond**)
4. It is the columnar arrangement of the elements in the periodic table of elements. This determines the number of valence elect (**group**)
6. These are types of elements that tend to lose electrons during chemical bonding. (**metals**)
7. It refers to the arrangement of elements in the periodic table of elements that determines the number or energy shell of each (**period**)
9. It uses dots to represent the valence electrons of the atom. (**leds**)

3. It refers to the positively charge ions. (**cation**)
5. A type of element that tends to gain electrons after chemical bonding. (**nonmetal**)
8. It refers to the electrons involved in chemical bonding. (**valenceelectron**)



	<div> Assessment <ol style="list-style-type: none"> 1. B 2. D 3. A 4. C 5. A 6. A 7. A 8. D 9. C 10. D </div>
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References

Books:

Alvarez, Liza A., Dave G. Angeles, Hernan L. Apurada, Ma. Pilar P. Carmona, Oliver A. Lahorra, Judith F. Marcaida, Ma. Regaele A. Olarte, Estrella C. Osorio, Digna C. Paningbatan, Marivic S. Rosales, and Ma. Teresa B. Delos Santos. *Science - Grade 9 Learner's Module*. Pasig City: Department of Education, 2014, 50-71.

Online Resources:

Ionic Bonding Comic Strip - Comic Book Strip by 2cc2c2d1. 5/6/2019.

<https://www.storyboardthat.com/storyboards/2cc2c2d1/ionic-bonding-comic-strip>

Others:

Ignacio, Marilou A., Teacher-made SIM, Are They The Perfect Match?

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